



# 25.125" BACK EDGE DISTANCE 6.125" DISTANCE FROM FRONT ANCHORS

Hilti PROFIS Engineering 3.0.77

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Phone   Fax:		E-Mail:	
Design:	Concrete - Apr 19, 2022	Date:	4/19/2022
Fastening point:			

### Specifier's comments:

## 1 Input data

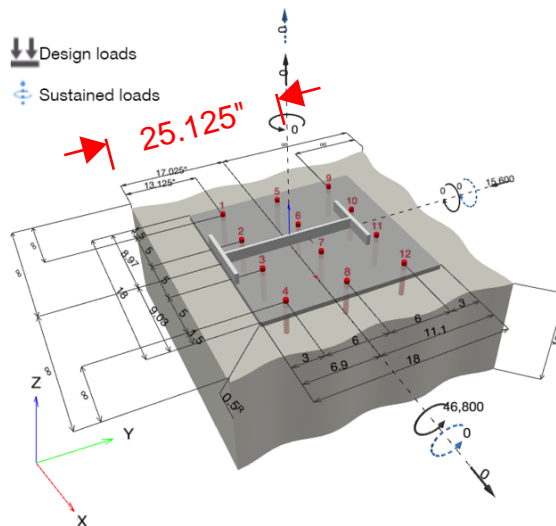


<b>Anchor type and diameter:</b>	<b>HIT-HY 200 + Rebar A 615 Gr.40 #4</b>
Item number:	not available (element) / 2022791 HIT-HY 200-A (adhesive)
Effective embedment depth:	$h_{ef,opti} = 3.026$ in. ( $h_{ef,limit} = 10.000$ in.)
Material:	ASTM A 615 GR.40
Evaluation Service Report:	ESR-3187
Issued   Valid:	5/1/2021   3/1/2022
Proof:	Design Method ACI 318-11 / Chem
Stand-off installation:	$e_b = 0.000$ in. (no stand-off); $t = 0.500$ in.
Anchor plate <sup>R</sup> :	$l_x \times l_y \times t = 18.000$ in. x $18.000$ in. x $0.500$ in.; (Recommended plate thickness: not calculated)
Profile:	W shape (AISC), W14X30; (L x W x T x FT) = $13.800$ in. x $6.730$ in. x $0.270$ in. x $0.385$ in.
Base material:	cracked concrete, 5000, $f'_c = 5,000$ psi; $h = 12.000$ in., Temp. short/long: 32/32 °F
<b>Installation:</b>	<b>hammer drilled hole, Installation condition: Dry</b>
Reinforcement:	tension: condition B, shear: condition B; no supplemental splitting reinforcement present edge reinforcement: none or < No. 4 bar

Note: the HIT-HY 200 + Rebar A 615 Gr.40 anchor is in the process of phase-out. As a result, there is limited/no inventory available. Application also possible with HIT-HY 200 V3 + Rebar A 615 Gr.40 under the selected boundary conditions.

<sup>R</sup> - The anchor calculation is based on a rigid anchor plate assumption.

### Geometry [in.] & Loading [lb, in.lb]



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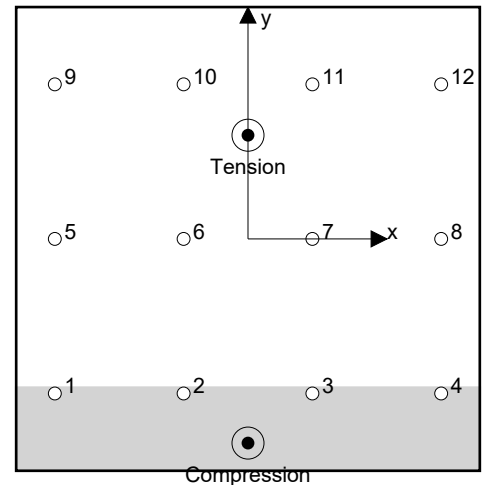
**1.1 Design results**

Case	Description	Forces [lb] / Moments [in.lb]	Seismic	Max. Util. Anchor [%]
1	Combination 1	$N = 0; V_x = 0; V_y = -15,600;$ $M_x = 46,800; M_y = 0; M_z = 0;$ $N_{sus} = 0; M_{x,sus} = 0; M_{y,sus} = 0;$	no	100

**2 Load case/Resulting anchor forces**
**Anchor reactions [lb]**

Tension force: (+Tension, -Compression)

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	0	1,305	4	-1,305
2	0	1,302	4	-1,302
3	0	1,298	4	-1,298
4	0	1,295	4	-1,295
5	322	1,305	0	-1,305
6	322	1,302	0	-1,302
7	322	1,298	0	-1,298
8	322	1,295	0	-1,295
9	657	1,305	-4	-1,305
10	657	1,302	-4	-1,302
11	657	1,298	-4	-1,298
12	657	1,295	-4	-1,295



max. concrete compressive strain: 0.03 [%]  
 max. concrete compressive stress: 135 [psi]  
 resulting tension force in (x/y)=(0.000/4.026): 3,916 [lb]  
 resulting compression force in (x/y)=(0.000/-7.925): 3,916 [lb]

Anchor forces are calculated based on the assumption of a rigid anchor plate.

**3 Tension load**

	Load $N_{ua}$ [lb]	Capacity $\phi N_n$ [lb]	Utilization $\beta_N = N_{ua} / \phi N_n$	Status
Steel Strength*	657	7,800	9	OK
Bond Strength**	3,916	10,135	39	OK
Sustained Tension Load Bond Strength*	N/A	N/A	N/A	N/A
Concrete Breakout Failure**	3,916	14,778	27	OK

\* highest loaded anchor    \*\*anchor group (anchors in tension)



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3.1 Steel Strength

$N_{sa}$  = ESR value refer to ICC-ES ESR-3187  
 $\phi N_{sa} \geq N_{ua}$  ACI 318-11 Table D.4.1.1

Variables

$A_{se,N}$ [in. <sup>2</sup> ]	$f_{uta}$ [psi]
0.20	60,000

Calculations

$N_{sa}$ [lb]
12,000

Results

$N_{sa}$ [lb]	$\phi_{steel}$	$\phi N_{sa}$ [lb]	$N_{ua}$ [lb]
12,000	0.650	7,800	657

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**3.2 Bond Strength**

$$N_{ag} = \left( \frac{A_{Na}}{A_{Na0}} \right) \Psi_{ec1,Na} \Psi_{ec2,Na} \Psi_{ed,Na} \Psi_{cp,Na} N_{ba} \quad \text{ACI 318-11 Eq. (D-19)}$$

$$\phi N_{ag} \geq N_{ua} \quad \text{ACI 318-11 Table D.4.1.1}$$

$$A_{Na} \text{ see ACI 318-11, Part D.5.5.1, Fig. RD.5.5.1(b)}$$

$$A_{Na0} = (2 c_{Na})^2 \quad \text{ACI 318-11 Eq. (D-20)}$$

$$c_{Na} = 10 d_a \sqrt{\frac{\tau_{uncr}}{1100}} \quad \text{ACI 318-11 Eq. (D-21)}$$

$$\Psi_{ec,Na} = \left( \frac{1}{1 + \frac{e_N}{c_{Na}}} \right) \leq 1.0 \quad \text{ACI 318-11 Eq. (D-23)}$$

$$\Psi_{ed,Na} = 0.7 + 0.3 \left( \frac{c_{a,min}}{c_{Na}} \right) \leq 1.0 \quad \text{ACI 318-11 Eq. (D-25)}$$

$$\Psi_{cp,Na} = \text{MAX} \left( \frac{c_{a,min}}{c_{ac}}, \frac{c_{Na}}{c_{ac}} \right) \leq 1.0 \quad \text{ACI 318-11 Eq. (D-27)}$$

$$N_{ba} = \lambda_a \cdot \tau_{k,c} \cdot \pi \cdot d_a \cdot h_{ef} \quad \text{ACI 318-11 Eq. (D-22)}$$

**Variables**

$\tau_{k,c,uncr}$ [psi]	$d_a$ [in.]	$h_{ef}$ [in.]	$c_{a,min}$ [in.]	$\alpha_{overhead}$	$\tau_{k,c}$ [psi]
1,673	0.500	3.026	19.125	1.000	1,158
$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{ac}$ [in.]	$\lambda_a$		
0.000	1.026	4.903	1.000		

**Calculations**

$c_{Na}$ [in.]	$A_{Na}$ [in. <sup>2</sup> ]	$A_{Na0}$ [in. <sup>2</sup> ]	$\Psi_{ed,Na}$
6.138	498.45	150.68	1.000
$\Psi_{ec1,Na}$	$\Psi_{ec2,Na}$	$\Psi_{cp,Na}$	$N_{ba}$ [lb]
1.000	0.857	1.000	5,501

**Results**

$N_{ag}$ [lb]	$\phi_{bond}$	$\phi N_{ag}$ [lb]	$N_{ua}$ [lb]
15,593	0.650	10,135	3,916

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**3.3 Concrete Breakout Failure**

$$N_{cbg} = \left( \frac{A_{Nc}}{A_{Nc0}} \right) \psi_{ec,N} \psi_{ed,N} \psi_{c,N} \psi_{cp,N} N_b \quad \text{ACI 318-11 Eq. (D-4)}$$

$$\phi N_{cbg} \geq N_{ua} \quad \text{ACI 318-11 Table D.4.1.1}$$

$$A_{Nc0} = 9 h_{ef}^2 \quad \text{ACI 318-11 Eq. (D-5)}$$

$$\psi_{ec,N} = \left( \frac{1}{1 + \frac{2 e_N}{3 h_{ef}}} \right) \leq 1.0 \quad \text{ACI 318-11 Eq. (D-8)}$$

$$\psi_{ed,N} = 0.7 + 0.3 \left( \frac{c_{a,min}}{1.5 h_{ef}} \right) \leq 1.0 \quad \text{ACI 318-11 Eq. (D-10)}$$

$$\psi_{cp,N} = \text{MAX} \left( \frac{c_{a,min}}{c_{ac}}, \frac{1.5 h_{ef}}{c_{ac}} \right) \leq 1.0 \quad \text{ACI 318-11 Eq. (D-12)}$$

$$N_b = k_c \lambda_a \sqrt{f'_c} h_{ef}^{1.5} \quad \text{ACI 318-11 Eq. (D-6)}$$

**Variables**

$h_{ef}$ [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]	$\psi_{c,N}$
3.026	0.000	1.026	19.125	1.000
$c_{ac}$ [in.]	$k_c$	$\lambda_a$	$f'_c$ [psi]	
4.903	17	1.000	5,000	

**Calculations**

$A_{Nc}$ [in. <sup>2</sup> ]	$A_{Nc0}$ [in. <sup>2</sup> ]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	$N_b$ [lb]
363.00	82.39	1.000	0.816	1.000	1.000	6,326

**Results**

$N_{cbg}$ [lb]	$\phi_{concrete}$	$\phi N_{cbg}$ [lb]	$N_{ua}$ [lb]
22,736	0.650	14,778	3,916



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### 4 Shear load

	Load $V_{ua}$ [lb]	Capacity $\phi V_n$ [lb]	Utilization $\beta_v = V_{ua} / \phi V_n$	Status
Steel Strength*	1,305	4,320	31	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength (Bond Strength controls)**	15,600	33,678	47	OK
Concrete edge failure in direction y-**	15,600	17,988	87	OK

\* highest loaded anchor    \*\*anchor group (relevant anchors)

#### 4.1 Steel Strength

$V_{sa}$  = ESR value      refer to ICC-ES ESR-3187  
 $\phi V_{steel} \geq V_{ua}$       ACI 318-11 Table D.4.1.1

#### Variables

$A_{se,V}$ [in. <sup>2</sup> ]	$f_{uta}$ [psi]
0.20	60,000

#### Calculations

$V_{sa}$ [lb]
7,200

#### Results

$V_{sa}$ [lb]	$\phi_{steel}$	$\phi V_{sa}$ [lb]	$V_{ua}$ [lb]
7,200	0.600	4,320	1,305

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**4.2 Pryout Strength (Bond Strength controls)**

$$V_{cpq} = k_{cp} \left[ \left( \frac{A_{Na}}{A_{Na0}} \right) \psi_{ec1,Na} \psi_{ec2,Na} \psi_{ed,Na} \psi_{cp,Na} N_{ba} \right] \quad \text{ACI 318-11 Eq. (D-41)}$$

$$\phi V_{cpq} \geq V_{ua} \quad \text{ACI 318-11 Table (D.4.1.1)}$$

$$A_{Na} \text{ see ACI 318-11, Part D.5.5.1, Fig. RD.5.5.1(b)}$$

$$A_{Na0} = (2 c_{Na})^2 \quad \text{ACI 318-11 Eq. (D-20)}$$

$$c_{Na} = 10 d_a \sqrt{\frac{\tau_{uncr}}{1100}} \quad \text{ACI 318-11 Eq. (D-21)}$$

$$\psi_{ec,Na} = \left( \frac{1}{1 + \frac{e_N}{c_{Na}}} \right) \leq 1.0 \quad \text{ACI 318-11 Eq. (D-23)}$$

$$\psi_{ed,Na} = 0.7 + 0.3 \left( \frac{c_{a,min}}{c_{na}} \right) \leq 1.0 \quad \text{ACI 318-11 Eq. (D-25)}$$

$$\psi_{cp,Na} = \text{MAX} \left( \frac{c_{a,min}}{c_{ac}}, \frac{c_{Na}}{c_{ac}} \right) \leq 1.0 \quad \text{ACI 318-11 Eq. (D-27)}$$

$$N_{ba} = \lambda_a \cdot \tau_{k,c} \cdot \pi \cdot d_a \cdot h_{ef} \quad \text{ACI 318-11 Eq. (D-22)}$$

**Variables**

$k_{cp}$	$\alpha_{overhead}$	$\tau_{k,c,uncr}$ [psi]	$d_a$ [in.]	$h_{ef}$ [in.]	$c_{a,min}$ [in.]	$\tau_{k,c}$ [psi]
2	1.000	1,673	0.500	3.026	13.125	1,158
$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{ac}$ [in.]	$\lambda_a$			
0.030	0.000	4.903	1.000			

**Calculations**

$c_{Na}$ [in.]	$A_{Na}$ [in. <sup>2</sup> ]	$A_{Na0}$ [in. <sup>2</sup> ]	$\psi_{ed,Na}$
6.138	662.10	150.68	1.000
$\psi_{ec1,Na}$	$\psi_{ec2,Na}$	$\psi_{cp,Na}$	$N_{ba}$ [lb]
0.995	1.000	1.000	5,501

**Results**

$V_{cpq}$ [lb]	$\phi_{concrete}$	$\phi V_{cpq}$ [lb]	$V_{ua}$ [lb]
48,111	0.700	33,678	15,600



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4.3 Concrete edge failure in direction y-

$$V_{cbg} = \left( \frac{A_{Vc}}{A_{Vc0}} \right) \Psi_{ec,V} \Psi_{ed,V} \Psi_{c,V} \Psi_{h,V} \Psi_{parallel,V} V_b \quad \text{ACI 318-11 Eq. (D-31)}$$

$$\phi V_{cbg} \geq V_{ua} \quad \text{ACI 318-11 Table D.4.1.1}$$

$A_{Vc}$  see ACI 318-11, Part D.6.2.1, Fig. RD.6.2.1(b)

$$A_{Vc0} = 4.5 c_{a1}^2 \quad \text{ACI 318-11 Eq. (D-32)}$$

$$\Psi_{ec,V} = \left( \frac{1}{1 + \frac{2e_v}{3c_{a1}}} \right) \leq 1.0 \quad \text{ACI 318-11 Eq. (D-36)}$$

$$\Psi_{ed,V} = 0.7 + 0.3 \left( \frac{c_{a2}}{1.5c_{a1}} \right) \leq 1.0 \quad \text{ACI 318-11 Eq. (D-38)}$$

$$\Psi_{h,V} = \sqrt{\frac{1.5c_{a1}}{h_a}} \geq 1.0 \quad \text{ACI 318-11 Eq. (D-39)}$$

$$V_b = \left( 7 \left( \frac{l_e}{d_a} \right)^{0.2} \sqrt{d_a} \right) \lambda_a \sqrt{f'_c} c_{a1}^{1.5} \quad \text{ACI 318-11 Eq. (D-33)}$$

Variables

$c_{a1}$ [in.]	$c_{a2}$ [in.]	$e_{cV}$ [in.]	$\Psi_{c,V}$	$h_a$ [in.]
13.125	-	0.017	1.000	12.000
$l_e$ [in.]	$\lambda_a$	$d_a$ [in.]	$f'_c$ [psi]	$\Psi_{parallel,V}$
3.026	1.000	0.500	5,000	1.000

Calculations

$A_{Vc}$ [in. <sup>2</sup> ]	$A_{Vc0}$ [in. <sup>2</sup> ]	$\Psi_{ec,V}$	$\Psi_{ed,V}$	$\Psi_{h,V}$	$V_b$ [lb]
652.50	775.20	0.999	1.000	1.281	23,855

Results

$V_{cbg}$ [lb]	$\phi_{concrete}$	$\phi V_{cbg}$ [lb]	$V_{ua}$ [lb]
25,697	0.700	17,988	15,600

COMPARISON OF FRONT EDGE SHEAR CAPACITY OF ONLY ANCHORS CLOSEST TO EDGE VS TOTAL ULTIMATE LOAD?

5 Combined tension and shear loads

$\beta_N$	$\beta_V$	$\zeta$	Utilization $\beta_{N,V}$ [%]	Status
0.386	0.867	5/3	100	OK

$$\beta_{NV} = \beta_N^{\zeta} + \beta_V^{\zeta} \leq 1$$



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## 6 Warnings

- The anchor design methods in PROFIS Engineering require rigid anchor plates per current regulations (AS 5216:2021, ETAG 001/Annex C, EOTA TR029 etc.). This means load re-distribution on the anchors due to elastic deformations of the anchor plate are not considered - the anchor plate is assumed to be sufficiently stiff, in order not to be deformed when subjected to the design loading. PROFIS Engineering calculates the minimum required anchor plate thickness with CBFEM to limit the stress of the anchor plate based on the assumptions explained above. The proof if the rigid anchor plate assumption is valid is not carried out by PROFIS Engineering. Input data and results must be checked for agreement with the existing conditions and for plausibility!
- Condition A applies where the potential concrete failure surfaces are crossed by supplementary reinforcement proportioned to tie the potential concrete failure prism into the structural member. Condition B applies where such supplementary reinforcement is not provided, or where pullout or pryout strength governs.
- Design Strengths of adhesive anchor systems are influenced by the cleaning method. Refer to the INSTRUCTIONS FOR USE given in the Evaluation Service Report for cleaning and installation instructions.
- For additional information about ACI 318 strength design provisions, please go to <https://submittals.us.hilti.com/PROFISAnchorDesignGuide/>
- Installation of Hilti adhesive anchor systems shall be performed by personnel trained to install Hilti adhesive anchors. Reference ACI 318-11, Part D.9.1

**Fastening meets the design criteria!**

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## 7 Installation data

Profile: W shape (AISC), W14X30; (L x W x T x FT) = 13.800 in. x 6.730 in. x 0.270 in. x 0.385 in.

Hole diameter in the fixture:  $d_f = 0.500$  in.

Plate thickness (input): 0.500 in.

Recommended plate thickness: not calculated

Drilling method: Hammer drilled

Cleaning: Compressed air cleaning of the drilled hole according to instructions for use is required

Anchor type and diameter: HIT-HY 200 + Rebar A 615 Gr.40 #4

Item number: not available (element) / 2022791 HIT-HY 200-A (adhesive)

Maximum installation torque: -

Hole diameter in the base material: 0.625 in.

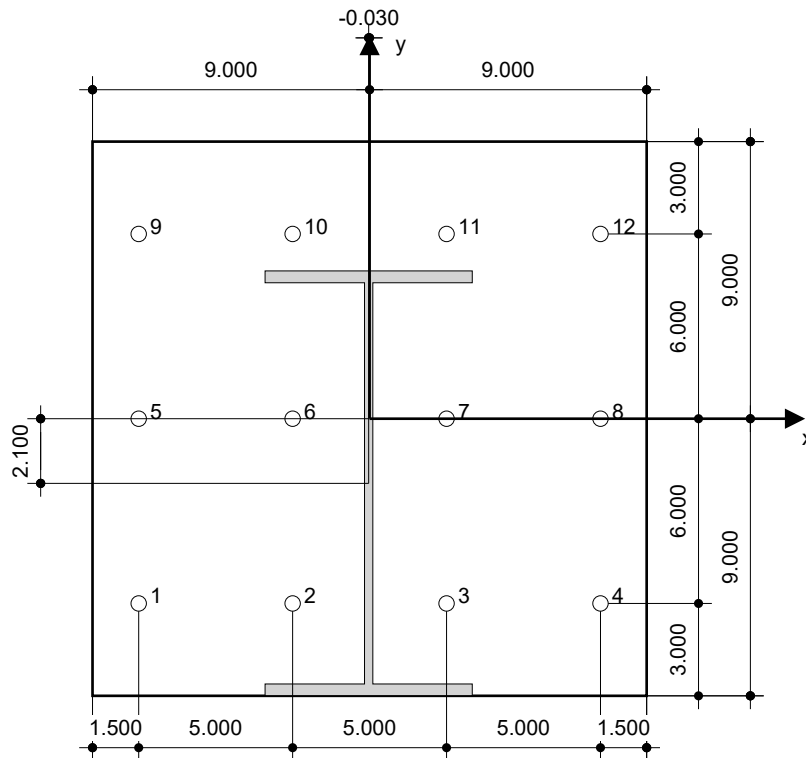
Hole depth in the base material: 3.026 in.

Minimum thickness of the base material: 4.276 in.

#4 Rebar with Hilti HIT-HY 200 Safe Set System

### 7.1 Recommended accessories

Drilling	Cleaning	Setting
<ul style="list-style-type: none"> <li>• Suitable Rotary Hammer</li> <li>• Properly sized drill bit</li> </ul>	<ul style="list-style-type: none"> <li>• Compressed air with required accessories to blow from the bottom of the hole</li> <li>• Proper diameter wire brush</li> </ul>	<ul style="list-style-type: none"> <li>• Dispenser including cassette and mixer</li> <li>• For deep installations, a piston plug is necessary</li> <li>• Torque wrench</li> </ul>





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## Coordinates Anchor [in.]

Anchor	x	y	C <sub>-x</sub>	C <sub>+x</sub>	C <sub>-y</sub>	C <sub>+y</sub>	Anchor	x	y	C <sub>-x</sub>	C <sub>+x</sub>	C <sub>-y</sub>	C <sub>+y</sub>
1	-7.500	-6.000	-	-	13.125	-	7	2.500	0.000	-	-	19.125	-
2	-2.500	-6.000	-	-	13.125	-	8	7.500	0.000	-	-	19.125	-
3	2.500	-6.000	-	-	13.125	-	9	-7.500	6.000	-	-	25.125	-
4	7.500	-6.000	-	-	13.125	-	10	-2.500	6.000	-	-	25.125	-
5	-7.500	0.000	-	-	19.125	-	11	2.500	6.000	-	-	25.125	-
6	-2.500	0.000	-	-	19.125	-	12	7.500	6.000	-	-	25.125	-



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## 8 Remarks; Your Cooperation Duties

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